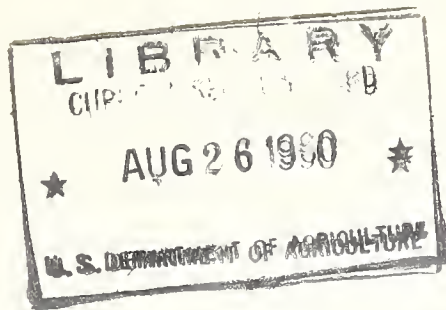


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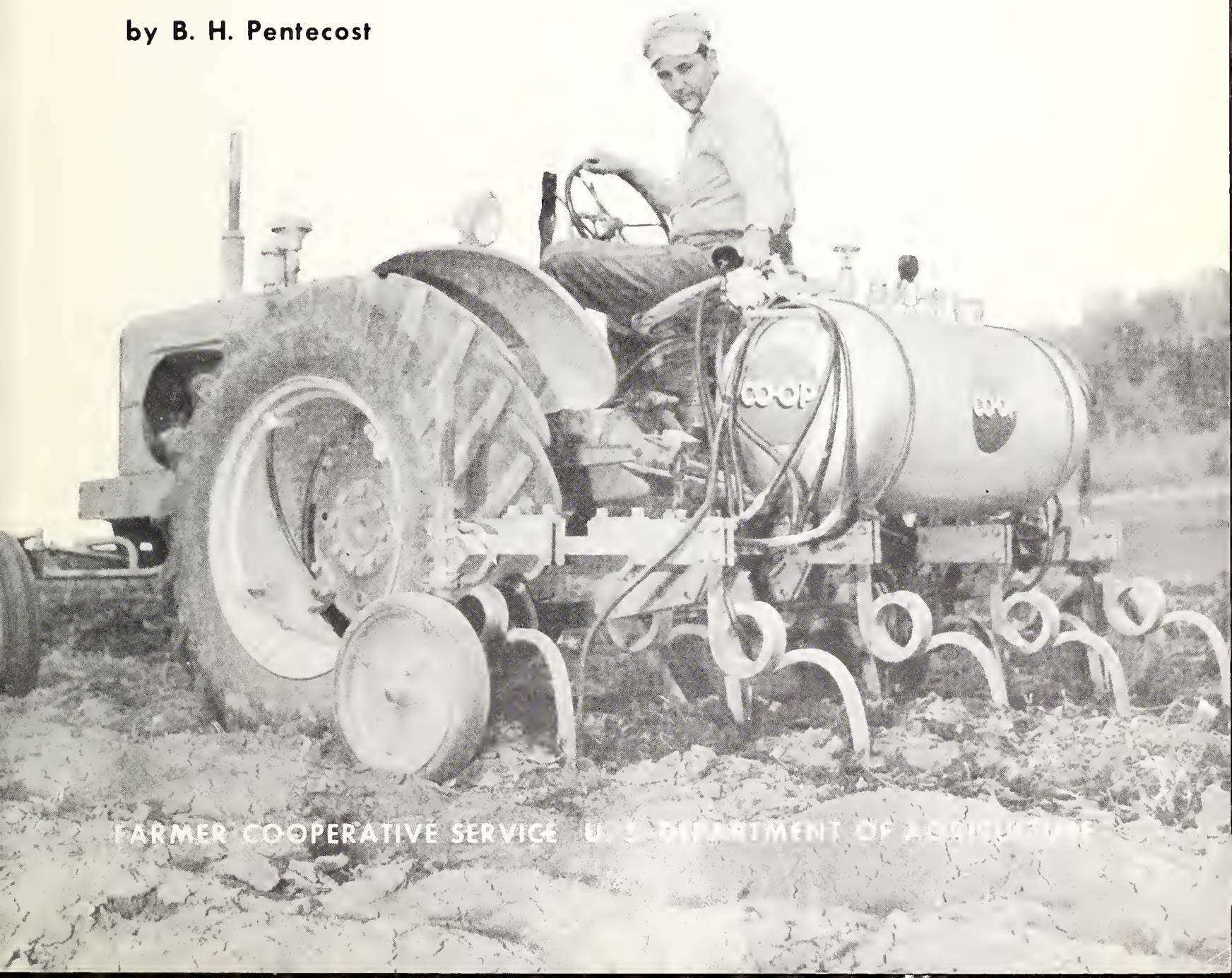


GENERAL REPORT 82
JULY 1960

Liquid Nitrogen Distribution

by Local Cooperatives in Nebraska and Kansas

by B. H. Pentecost



FARMER COOPERATIVE SERVICE U.S. DEPARTMENT OF AGRICULTURE

FARMER COOPERATIVE SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

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The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, financing, merchandising, product quality, costs, efficiency, and membership.

The Service publishes the results of such studies; confers and advises with officials of farmer cooperatives, and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

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Summary

*This study covered liquid nitrogen fertilizer distribution by 17 local cooperatives in Nebraska and Kansas affiliated with Consumer Cooperative Association (CCA) Kansas City, Mo. CCA suggested these for study as among the most successful in distributing liquid nitrogen in their areas. Farmer Cooperative Service obtained data on them in June 1959. Main objectives of the study were to determine: (1) Type, size, cost, and adequacy of facilities and equipment used, (2) operating practices and policies followed, and (3) problems and possibilities for improving distribution services to farmers.

*The types of liquid nitrogen handled by the associations surveyed were: (1) High-pressure anhydrous ammonia (NH_3), and (2) low-pressure and non-pressure nitrogen solutions. Anhydrous ammonia was used more for side-dressing, but also as a preplant application in the spring on corn and milo. Some, however, was used on wheat both before and after planting and through irrigation water. Nitrogen solutions were used on row crops, both before planting and later as a side-dressing. They were also used on wheat in the spring and fall and on other small grains and pastures.

*Of the 17 associations, 12 were distributing anhydrous ammonia and 14 were handling nitrogen solutions. Nine of the 17 distributed both types. All associations distributing anhydrous ammonia had begun such operations before 1956 and were,

therefore, well established. Only four associations, however, had begun distributing nitrogen solutions before the spring of 1959.

*Most associations began handling liquid nitrogen to provide patrons with a needed service at minimum costs. In some communities they added it as a new service. In others they began it to maintain their position in the fertilizer business.

Facilities

*The 12 associations distributing anhydrous ammonia owned a total of 20 bulk storage tanks ranging in size from 6,000 to 30,000 gallons. The 30,000-gallon tanks were most common and ranged in cost from \$9,000 for a used tank to \$19,200 for a new tank complete with an aluminum constructed pumphouse. The minimum cost of a 30,000-gallon tank complete and ready to begin operations was approximately \$13,400. If a delivery and application service was offered, the total investment increased according to the number of nurse tanks (used to transport liquid material) and applicators used.

*Six associations distributing nitrogen solutions owned aluminum storage tanks and eight owned mild steel tanks (table 4). The cost of aluminum tanks ranged from \$2,250 for a 7,000-gallon tank to \$7,955

for a 23,000-gallon tank. The most common size was 22,000 gallons ranging in cost from \$6,500 to \$7,105. The cost of mild steel tanks was about half that of aluminum tanks of equal size. In addition to bulk plant facilities, most associations also owned nurse tanks and applicators and performed a custom application service for patrons or furnished them equipment on a rental basis.

*The 17 associations owned 109 of the 1,000-gallon anhydrous ammonia nurse tanks. Seventy-eight of those tanks were mounted on trailers. The associations also owned 72 of the 500-gallon tanks, with 57 of them mounted on trailers. Five associations owned some of both sizes. The cost of 1,000-gallon tanks mounted on four-wheel trailers averaged approximately \$845. Without trailers the cost ranged from \$540 to \$600. The 500-gallon tanks ranged in cost from \$275 for the tank alone to \$550 for a tank mounted on a trailer.

*The 15 associations distributing nitrogen solutions owned 28 aluminum and 12 steel nurse tanks. The cost of 1,000-gallon aluminum tanks ranged from \$600 to \$800. The costs of 500- to 550-gallon tanks were from \$300 to \$400, depending on quality of construction.

*Ten associations owned 27 anhydrous ammonia applicators. They ranged in cost from \$350 for a tractor-mounted one to \$750 for a pull-type applicator. Their average cost was \$610.

*Thirteen associations owned a total of 43 nitrogen solution applicators. Their cost ranged from \$275 for a trailer tank equipped with a

sprayer to \$1,700 for a self-propelled applicator.

Operations

*Anhydrous ammonia accounted for 70 percent of the nitrogen fertilizers sold and for 66 percent of all fertilizers sold by the reporting associations in 1958-59. The average sales of anhydrous were \$111,021 per association.

*All cooperatives included in the study obtained anhydrous from their regional association, CCA, which operates a plant at Lawrence, Kans. The cooperatives bought solutions from several sources, and many were experiencing difficulties in obtaining adequate supplies in the spring of 1959.

*The cooperatives' price for anhydrous ammonia sold to patrons varied from 6.7 cents a pound--or \$110 a ton f.o.b. bulk plant--to 9.76 cents a pound for nitrogen--or \$160 a ton delivered and applied. The price of nitrogen solutions to patrons ranged from 10.2 cents a pound f.o.b. plant to 13.4 cents per pound of nitrogen delivered and applied. These prices were equivalent to from \$57 to \$75 a ton for 28 percent nitrogen and from \$65 to \$86 a ton for 32 percent nitrogen solutions.

*Five associations reported they operated on a cash basis. Credit policies of nine varied from 10 to 30 days, with some offering incentives to encourage early payment. Three cooperatives did not have a definite credit policy.

*Most of the anhydrous ammonia and nitrogen solutions used were

transported from bulk plants to farms by nurse tanks mounted on trailers designed for that purpose. Some was moved in nurse tanks on skids in trucks or farm trailers. The power source was either tractor, truck, or jeep.

*Personnel employed in handling anhydrous ammonia were instructed in safety precautions and emergency first aid in case of exposure to ammonia fumes. Reports indicated, however, that some employees did not always follow all recommended safety precautions, especially during rush periods.

*Sales promotion was planned to meet patrons' needs for further education in fertilization practices. Nine associations employed fieldmen to work with patrons and help them plan fertilization programs according to their needs. Eleven associations held at least one fertilizer meeting a year to inform patrons and promote sales, and three had demonstration plots or check strips to show results of fertilization. Incentives were used by only three associations.

*Three associations provided custom application services to patrons for anhydrous ammonia. Rates ranged from \$1.25 to \$1.50 an acre. Six associations performed such a service for nitrogen solutions with charges usually ranging from 50 to 75 cents an acre.

*Twenty-three applicators for nitrogen solutions were available for rental to patrons from 11 associations. Most charged from 25 cents to 50 cents an acre. Two charged three-fourths of a cent per pound of nitrogen and one made no charge.

*Eight cooperatives were using the services of 28 private custom applicators for nitrogen solutions as a means of increasing services to patrons and improving the cooperatives' distribution systems. Five cooperatives paid the applicators for their services, and patrons of three associations dealt directly with applicators.

*Other services included soil sampling by 8 associations; field personnel to assist farmers with application problems by 9 and an inventory of parts and hoses for solutions by 12 associations.

*For five associations reporting, gross margins on anhydrous ammonia averaged 23 percent of sales and the average patronage refund paid was 16 percent.

*Six of nine associations handling both anhydrous and nitrogen solutions reported that their patrons preferred the former because of its lower cost. They indicated, however, solutions were gaining in popularity because of their wider adaptability to soil conditions.

*Twelve of 17 managers interviewed said liquid fertilizers were causing dry nitrogen sales to decrease. Nine of the 12 said their dry sales had been almost or completely eliminated.

*Thirteen associations expected farmers to use considerably more liquid nitrogen in the future. They also expected the number of distributors to increase. Therefore, 10 of the 17 associations surveyed were planning to expand facilities or to begin distributing both types of liquid nitrogen fertilizer.

Suggestions

Some associations might improve their operations and services by considering the following:

- *Provide complete services to farmers including rental of equipment and custom application of the product, or arrange for application by commercial applicators.

- *Improve peak season operations by handling both nitrogen solutions and anhydrous ammonia and obtaining more trackage to prevent storage problems.

- *Encourage fall use of liquids to make more efficient use of facilities and labor.

- *Encourage prompt return of equipment by patrons to minimize investment in it and to have equipment always available for rental or loan.

- *Take proper care of equipment to keep corrosion to a minimum. Follow safety precautions at all times.

- *Keep better records on distribution of anhydrous and solutions to accurately know trends in expenses and net savings.

Liquid Nitrogen Distribution

by Local Cooperatives in Nebraska and Kansas

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The use of liquid fertilizers for direct application to soils has been of interest to farmers for many years. Liquid mixed fertilizers were applied in irrigation water by California farmers in the 1920's, but

anhydrous ammonia (NH_3) was not used for crop production until a few years before World War II. It was not until after the war, when Government-operated ammonia plants were sold to private industry, that production of liquid nitrogen fertilizers increased significantly. Since that time they have gained widespread acceptance by farmers and consumption continues to increase rapidly (table 1).

TABLE 1.--Liquid nitrogen fertilizers consumed as direct application materials in the United States, 1947 and 1953-58

Years ended June 30	Anhydrous ammonia	Aqua ammonia	Nitrogen solutions
		<i>Tons</i>	
1947	25,061	¹ 572	7,049
1953	217,182	¹ 72,917	--
1954	350,477	¹ 191,592	--
1955	353,681	231,808	108,766
1956	418,454	309,948	108,895
1957	452,702	381,432	245,878
1958	583,434	365,062	324,546

¹Includes both aqua ammonia and nitrogen solutions.

Note: The author expresses appreciation to managers of local cooperatives who provided information for this study; to J. Warren Mather, Chief, Farm Supplies Branch, Farmer Cooperative Service; and to personnel of Consumers Cooperative Association, Kansas City, Mo., for assistance in planning and conducting the study.

In several areas farmer cooperatives have played an important role in expanding liquid nitrogen fertilizer distribution. Through their cooperatives, farmers have provided themselves with services they could not afford individually. Many cooperatives, in addition to purchasing liquid materials for patrons, also offer a custom application service at a cost less than patrons can do it for themselves. Other cooperatives provide applicators and sometimes delivery tanks on a rental basis for patrons who do not have sufficient acreage to economically justify owning their own equipment.

Farmers have requested their cooperatives to provide such services because they were not available or were unsatisfactory, because they wished to obtain such fertilizers at a saving, or because of a combination of these reasons.

Many of these cooperatives have had little experience in distributing liquid nitrogens and large numbers of cooperatives are interested in handling them. Therefore, this study was undertaken to provide useful information for both groups.

Purpose and Method of Study

The purposes of this study were to determine: (1) The type, size, cost, and adequacy of facilities and equipment used; (2) operating practices and policies followed; and (3) problems and possibilities for improving distribution services to farmers.

Seventeen local cooperatives affiliated with Consumers Cooperative Association (CCA), Kansas City, Mo., were selected for study. CCA fertilizer division personnel helped select these associations on the basis of their outstanding performances in sales and service. Eleven

associations were located in southeastern and central Nebraska and six were located in southwestern Kansas.

Available data were obtained by personal interviews with managers or fertilizer division heads, or both, in the local cooperatives.

Information on the experience and present facilities, operations, problems and plans of these associations should be helpful to them as well as to other cooperatives contemplating distributing liquid nitrogen fertilizers.

Types of Liquid Nitrogen Fertilizers Handled

Liquid nitrogens as used in this report include high-pressure anhydrous ammonia and low-pressure and non-pressure nitro-

gen solutions. A brief description of each is included. None of the associations handled aqua ammonia.

Anhydrous Ammonia

Anhydrous ammonia was the most concentrated and lowest priced nitrogenous material available in the spring of 1959. It contains 82 percent nitrogen and is the basic liquid fertilizer material. It is a colorless gas at atmospheric pressure and temperature--lighter than air; it is alkaline, and gives off a distinctively sharp odor.

Anhydrous ammonia is handled as a liquid at relatively high pressures and moderate temperatures. Therefore, high-pressure steel equipment is required in transferring and handling it. Sub-surface applicators are required for applying it 6 inches or more in the soil. It can be applied in irrigation water by use of a flow control regulator.

Nitrogen Solutions

There are two types of nitrogen solutions--low-pressure and non-pressure. They are made from ammonia gas, ammonium nitrate, and water. Urea is also used in some solutions. Commonly used low-pressure solutions contain from 37 to 41 percent nitrogen and are applied 2 inches or more under the soil surface, or in irrigation water.

Non-pressure solutions with from 28 to 32 percent nitrogen were most popular among the associations studied, but other proportions such as 16 and 21 percent were available. They may be applied in the soil, on the soil surface, or in irrigation water, with little or no significant loss of nitrogen. Detailed data is in the appendix.

Uses of Liquid Nitrogen Fertilizers

Anhydrous ammonia was used by cooperative patrons in the Nebraska and Kansas areas largely as a sidedressing on row crops such as corn and milo. Some, however, was also used before planting. The rates of application ranged from 30 to 65 pounds of nitrogen an acre on non-irrigated land and from 80 to 135 pounds on irrigated land. Some anhydrous was used on wheat as preplant, topdress, and irrigation water applications at rates ranging from 40 to 60 pounds of nitrogen an acre.

Nitrogen solutions were used on row crops both before planting and as a sidedressing, at rates similar to anhydrous ammonia. They were



Here anhydrous ammonia is being used to sidedress corn. Illustration on cover shows preplant application.

also used on wheat at rates ranging from 30 to 60 pounds of nitrogen an acre. Most was applied in spring; however, some was applied in the fall just before planting time. Nitrogen solutions were also used on other small grains and pastures at various rates of application.

At the time of this study, little liquid nitrogen fertilizers were used for fall application. All of the managers, however, were interested in the possibilities for more fall application and most of them were planning to start promoting it in the future.

Development and Current Volume

Nine of the 17 local associations studied were distributing both anhydrous ammonia and non-pressure nitrogen solutions in June 1959, 3 were distributing anhydrous ammonia only, 4 were distributing non-pressure nitrogen solutions only, and 1 was distributing both low-pressure and non-pressure solutions. Therefore, of the 17 associations studied, 12 were distributing anhydrous ammonia and 14 were distributing nitrogen solutions. However, 1 of the 12 had purchased the necessary facilities and equipment and planned to begin distributing nitrogen solutions in the fall of 1959.

All of the 12 associations handling anhydrous ammonia had begun operations between 1954 and 1956, but only 4 of the 14 associations distributing nitrogen solutions had begun handling them before the spring of 1959. Therefore, a larger portion of this report is centered around the 12 associations distributing anhydrous ammonia.

The primary reasons for beginning liquid fertilizer operations, as stated by managers of associations handling anhydrous ammonia, or nitrogen solutions, or both, was to give patrons a needed service at reasonable

prices--to meet the demand of patrons either for new service or for a service better than, or equal to, that already existing for farmers.

Only eight associations had records of sales of dry and liquid fertilizers (table 2). Of their total fertilizer sales of \$1,363,420, anhydrous ammonia represented \$904,290 or 66 percent. The average anhydrous ammonia volume per association was \$111,021, compared to \$170,428 for all fertilizers. Anhydrous ammonia was the primary nitrogen fertilizer sold by six of the eight associations. It averaged 69.7 percent of all nitrogen fertilizer they sold.

Nitrogen solutions volume is not reported because most of the associations studied had not been distributing them for a full year.

Secondary data on liquid fertilizer use by counties were not available for the areas studied; therefore, managers of the association were asked to estimate their share of the market in their respective areas. With respect to anhydrous ammonia, two managers estimated they handled 90 percent or more of the business in their area; one indicated 60 percent; and one 33 percent.

TABLE 2.--Volume of all fertilizers sold and percent that anhydrous ammonia was of total nitrogen and of all fertilizers, eight local farm supply cooperatives, 1958-59

Association code number	Anhydrous ammonia	Dry nitrogen	Total nitrogen	Anhydrous as percent of total nitrogen	Total volume of all ferti- lizers ¹	Anhydrous as percent of total fertilizer
	<i>Volume</i>	<i>Volume</i>	<i>Volume</i>	<i>Percent</i>	<i>Volume</i>	<i>Percent</i>
2	\$70,645	\$34,155	\$104,800	67.4	\$104,800	67.4
5	143,500	9,480	152,980	93.8	155,000	92.6
6	92,000	2,765	94,765	97.0	113,020	81.4
7	169,425	8,705	178,130	95.1	192,540	88.0
9	134,360	7,010	141,370	95.0	160,550	83.7
10	130,625	(²)	(²)	--	153,670	85.0
11	107,540	(²)	(²)	--	135,770	79.2
13	<u>56,195</u>	<u>228,000</u>	<u>284,195</u>	<u>19.8</u>	<u>348,070</u>	<u>16.1</u>
Total	904,290	290,115	956,240	--	1,363,420	--
Average	³ 111,021	48,353	159,373	³ 69.7	⁴ 170,428	⁴ 66.3

¹Includes both straight and mixed goods.

²Breakdown not available; included in total fertilizer volume.

³Based on six associations.

⁴Based on eight associations.

In distributing nitrogen solutions, managers of four associations estimated they handled 90 percent or more of the business in their area; one indicated 80 percent; one, 50

percent; and one, less than 50 percent. Two of the high-share group were the only distributors in their area and the other two had been operating a full year or longer.

Facilities and Equipment

This section of the report deals with bulk plant facilities and delivery and application equipment owned and operated by local cooperatives distributing anhydrous ammonia or nitrogen solutions, or both. Facilities for anhydrous ammonia and nitrogen solutions

are discussed under separate headings.

Plant Facilities

Plant facilities necessary for distributing liquid fertilizers include

bulk storage tanks and transfer equipment for moving the material from tank cars to storage tanks and from storage tanks to delivery equipment.

Anhydrous Ammonia

In June 1959, 12 associations distributing anhydrous ammonia owned a total of 20 steel bulk storage tanks. Capacity of the tanks ranged in size from 6,000 to 30,000 gallons. Complete information pertaining to initial cost, age, and present value of tanks was available for seven of these associations (table 3).

Five of the associations furnishing complete data owned one or more

30,000-gallon tanks, one owned both a 30,000-gallon and a 12,000-gallon tank, and one owned only a 12,000-gallon tank. The cost of the 12,000-gallon tank was \$9,000 complete with air compressor, connections, and hose. The cost of a 30,000-gallon storage tank ranged from \$9,000 for a used tank to \$19,200 for a new tank, complete with pump-house and equipment.

Although most of the associations bought their anhydrous storage plants complete with necessary equipment for transferring the material to and from the tanks, a few bought transfer equipment separately. Cost of this equipment ranged from \$250 for a small pumping unit up to approximately \$950 for a large complete



Bulk storage tanks: In rear right, anhydrous ammonia; center, nitrogen solutions; and left, liquid mixed. In right foreground is an NH_3 nurse tank and trailer in the loading area.

TABLE 3 --Capacity, cost, age, and book value of anhydrous ammonia bulk storage tanks owned by seven local farm supply cooperatives, June 1959

Association code number	Capacity	Cost	Age	Book value
	<i>Gallons</i>	<i>Dollars</i>	<i>Years</i>	<i>Dollars</i>
2	30,000	\$12,514	4	\$5,768
6	12,000	¹ 9,000	3	6,561
7	30,000	¹ 14,000	5	8,400
	30,000	9,000	5	6,400
8	30,000	² 23,000	5	13,581
9	30,000	¹ 13,386	5	9,403
10	30,000	¹ 19,200	5	15,012
	30,000	9,000	4	7,455
11	30,000	¹ 15,173	5	8,809
	12,000	8,460	4	6,874

¹ Includes cost of tank complete with necessary plant equipment to begin operations.

² Includes price paid for two 30,000-gallon tanks.

air compressor unit used for moving both anhydrous ammonia and nitrogen solutions.

Nitrogen Solutions

A total of 14 bulk storage tanks were owned and operated by 14 associations distributing nitrogen solutions in June 1959. Another association had purchased two 22,000-gallon tanks along with additional equipment and planned to begin operations in the fall of 1959.

Six associations owned aluminum tanks ranging in size from 7,000 gallons to 23,000 gallons. The cost of aluminum tanks ranged from \$2,250 for a 7,000-gallon tank to \$7,955 for a 23,000-gallon tank (table 4). The cost of mild steel storage tanks for nitrogen solutions ran considerably less than for aluminum tanks of the same sizes. Cost data were available for only three associations, but a total of eight associations were using storage

tanks constructed of mild steel. Six of the eight owned 22,000-gallon tanks and two owned 21,000-gallon tanks.

Of the three associations reporting cost of storage tanks, one paid \$3,550 and another \$3,500 for their 22,000-gallon tanks, and one paid \$2,850 for a 21,000-gallon tank.

Either an air compressor or pump is required for transferring nitrogen solutions from tank cars to storage tanks and from storage tanks to delivery tanks. The cost of transfer equipment varies considerably depending on the distance the material is to be moved and the rate of transfer desired. Different types of equipment were used by the associations, ranging from a \$100 gas-operated pumping unit to a \$650 complete air compressor unit. When air compressors are used for transferring solutions, the tanks must be constructed to withstand moderate pressure.

TABLE 4.--Material construction, capacity, and cost of nitrogen solutions bulk storage tanks, 15 local farm supply cooperatives, Kansas and Nebraska, June 1959

Association code number	Material construction	Capacity	Cost
		<i>Gallons</i>	
1	Aluminum	7,000	\$2,250
2	Aluminum	22,000	7,000
3	Aluminum	22,000	7,105
4	Aluminum	22,000	6,500
5	Mild steel	22,000	(2)
6	Aluminum	17,000	(2)
7	Mild steel	22,000	(2)
8	Mild steel	22,000	(2)
10	Aluminum ¹	23,000	7,955
12	Mild steel	22,000	3,550
14	Mild steel	21,000	(2)
15	Mild steel	22,000	(2)
16	Mild steel	22,000	3,500
17	Mild steel	21,000	2,850

¹ Information taken from audit report did not indicate type of material but cost indicates it was aluminum.

² Data unavailable.

Plant-to-Farm Equipment

Steel tanks are used for transporting high-pressure anhydrous ammonia from bulk storage plants to the farm. Both aluminum and mild steel tanks are used for transporting nitrogen solutions. These tanks are generally referred to as nurse or field tanks. Pumps or compressors may be used to transfer materials from nurse tanks to applicator tanks.

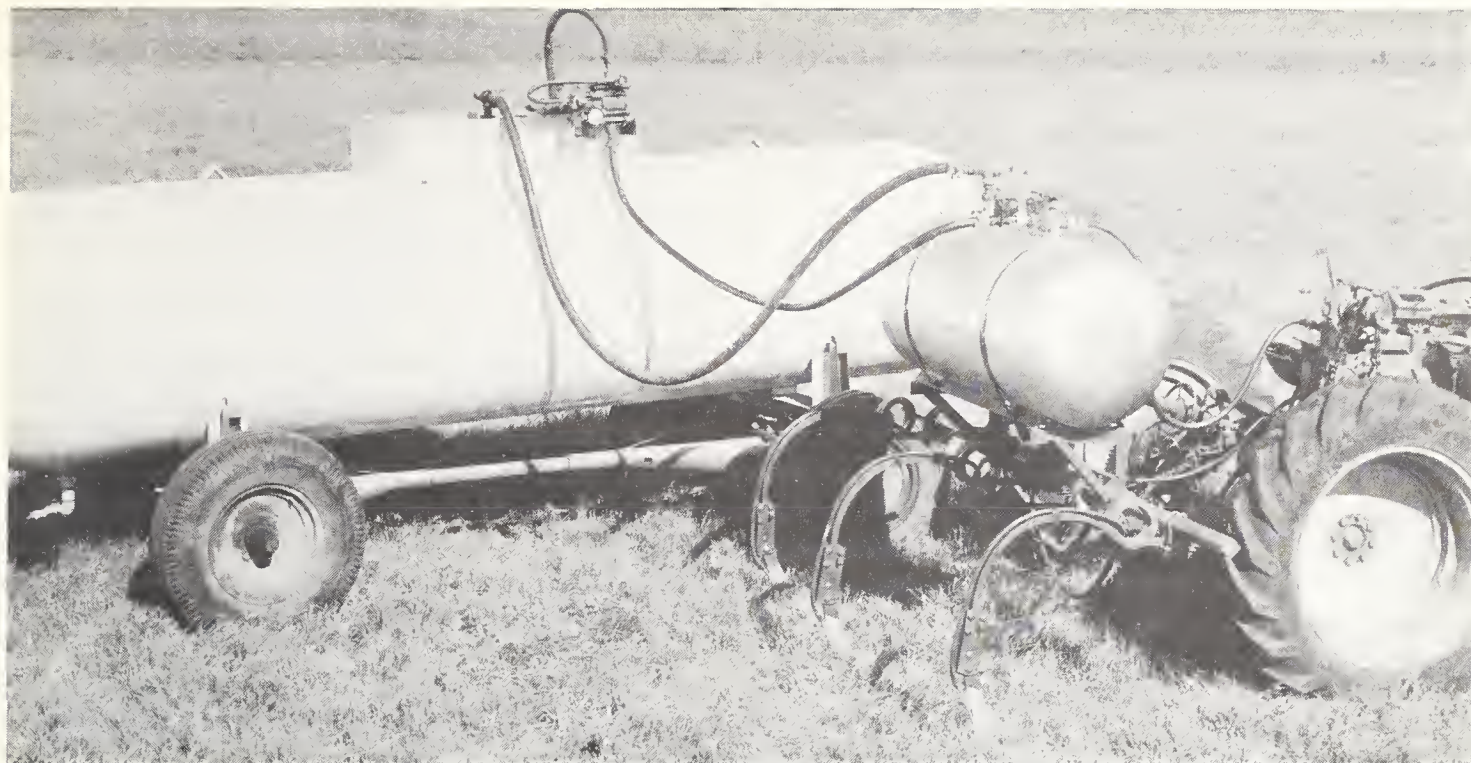
Anhydrous Ammonia

The number and size of nurse tanks generally indicate the size of operation. The size of nurse tanks used by the 12 associations studied varied from 500 to 1,000 gallons in capacity. Tanks were mounted either permanently on trucks or on trailers made to specification, or they were placed on skids and

transported with regular trucks and farm trailers. Those tanks not permanently mounted were handled with various types of booms and chain hoists.

The 12 associations owned 109 of the 1,000-gallon tanks, and 78 of them were mounted on trailers (table 5). They owned 72 of the 500-gallon tanks, with 57 of them mounted on trailers. Some of the trailers were adjustable and could be used for transporting different size tanks. Others, however, had permanently mounted tanks of either 1,000-gallon or 500-gallon capacity.

The average cost of a 1,000-gallon tank mounted on a four-wheel trailer was approximately \$845 at the time of this study. The cost of a nurse tank alone ran from \$540 to \$600. The cost of 500-gallon nurse tanks ranged from \$275 on skids to \$550 mounted on a trailer.



NH_3 is being transferred by vapor pump from nurse tank at left to a tractor-mounted applicator.

TABLE 5.--Number and size of anhydrous ammonia tanks owned, and number on trailers, 12 local farm supply cooperatives, June 1959

Association code number	Total number of tanks owned		Number of tanks on trailers	
	1,000 gal.	500-gal.	1,000 gal.	500-gal.
2	20	1	20	0
5	8	0	8	0
6	10	0	10	0
7	18	4	5	0
8	6	16	0	11
9	15	4	6	0
10	14	0	11	0
11	18	1	18	0
13	0	19	0	19
14	0	7	0	7
15	0	11	0	11
<u>17</u>	<u>0</u>	<u>9</u>	<u>0</u>	<u>9</u>
Total	109	72	78	57

Nitrogen Solutions

Most of the associations distributing nitrogen solutions had not

been operating a full year and thus had purchased only a limited amount of equipment. Therefore at the time of this study all managers, except

three, stated that they needed additional equipment for nitrogen solutions.

A total of 40 nurse tanks were owned by 13 associations. Fourteen were 1,000-gallon and 26 were from 500-gallon to 550-gallon tanks. Only three associations owned both sizes.

The 13 associations owned 9 trailers. When trailer-mounted tanks were not available, skid tanks were transported with trucks or farm trailers.

Six associations were using tanks constructed from light steel, six used aluminum, and one owned both steel and aluminum tanks. However, the associations owned only 12 steel tanks compared with 28 aluminum tanks.

The cost of a 1,000-gallon aluminum tank ranged from approximately \$600 to \$800. The cost of a 500-gallon to 550-gallon aluminum tank cost from \$300 to \$400, depending on how well they were constructed. Light steel tanks were approximately 50 percent less expensive than aluminum tanks depending on strength of construction. The cost of a 1,000-gallon steel tank ranged from approximately \$250 to \$400, while the 500-gallon to 550-gallon tanks cost from \$175 to \$275.

Tanks constructed from a lighter gauge steel could be bought cheaper, but at least two managers expressed dissatisfaction with lighter than 10-gauge steel tanks. They had previously tried tanks constructed of 14-gauge steel, but found them unsatisfactory because they were less durable. Another manager was dissatisfied with 500-gallon aluminum tanks. His association had discarded three such tanks after a short period

of use because they had begun leaking at the seams. While this did not mean that aluminum tanks were inferior, it did indicate the necessity for examining the construction of tanks and investigating the reputation of the manufacturer before purchasing them.

Application Equipment

Many farmers in the areas studied did not have sufficient acreage to warrant buying application equipment for their own use. Therefore, some cooperative managers found they could increase their volume of business considerably by purchasing one or more applicators for performing a custom service for patrons, or by furnishing them with application equipment on a rental basis. Thus the cooperatives, in addition to increasing their business volume, were giving patrons another needed service. A few associations also used the services of individuals, most often referred to as custom applicators, to apply liquid fertilizer for patrons.

Anhydrous Ammonia

Anhydrous ammonia is a liquid only when under pressure. It cannot be applied on the soil surface. Therefore, subsurface applicators are required. These applicators can be mounted on tractors or they can be tractor drawn. Some regular farm implements such as cultivators, chisel plows, and various plow-down rigs can be converted into anhydrous ammonia applicator equipment. Converter kits especially designed to fit standard farm equipment are available on the market. Accurate distribution is assured by use of metering pumps on applicators.



Anhydrous ammonia can also be applied in irrigation water by use of flow-control regulators.

Ten of the associations surveyed owned 27 anhydrous ammonia applicators. The number of associations owning specified numbers of applicators were:

Applicators owned per association	Associations reporting	Total applicators owned
<i>Number</i>	<i>Number</i>	<i>Number</i>
1	0	0
2	5	10
3	3	9
4	2	8
Total	10	27



Various farm implements can be rigged for NH_3 application. Top: Mold-board plow. In foreground is the nurse tank that transported NH_3 to the farm. Bottom: Field cultivator.

For those associations reporting cost data, the cost of applicators ranged from \$350 for a tractor-



mounted one to \$750 for a pull-type one and averaged \$610.

Managers of five of the associations distributing anhydrous ammonia reported that from 10 to 65 farmer patrons per association owned application equipment.

Only a few associations owned flow control regulators for applying anhydrous ammonia in irrigation water. However, at least two managers expressed relatively satisfactory results from this method of application in their areas. They indicated it was especially good for making applications after crops were too far advanced in growth to get through them with equipment. The



These are typical anhydrous ammonia applicators. Top: Tractor-mounted applicator. Bottom: Four-row pull-type applicator.



Here NH_3 is being transferred with a flow-control regulator from a 1,000-gallon nurse tank to irrigation water.

cost of a good unit was approximately \$65.

Nitrogen Solutions

Unlike anhydrous ammonia, non-pressure nitrogen solutions can be applied either under the surface or they can be sprayed on top of the soil without significant loss. Therefore, they can be applied when soil conditions are unfavorable to anhydrous ammonia application. They can also be applied to crops in later stages of maturity without damaging their root systems. The material can be applied to the soil through distribution nozzles either by gravity flow systems, pumps, or small air compressors. Self-propelled equipment is now on the market that has

adjustable booms for applying nitrogen solutions. It can be used at almost any stage of crop maturity and can also be used for the application of other spray materials.

Thirteen associations studied owned 43 nitrogen solutions applicators, and two did not own any. The number of associations owning specified numbers of applicators were as follows:

Applicators owned per association	Associations reporting	Total applicators owned
<i>Number</i>	<i>Number</i>	<i>Number</i>
1	1	1
2	6	12
3	4	12
6	1	6
12	1	12
Total	13	43

Only two associations owned more than three applicators. One of these owned 6 and the other owned 12. Eight of the associations had not been distributing nitrogen solutions a full year. However, most of their managers either already had made plans to purchase additional applicators or believed it would be necessary to purchase more in the near future to meet the demand.

The cost of nitrogen solutions applicators ranged from \$275 for a trailer tank equipped with sprayer to \$1,700 for a self-propelled applicator.

At the time of this study the use of nitrogen solutions was relatively

new and only five associations reported that any of their patrons owned applicators. Three of these associations had been operating a full year or more and two had not. Two of the former reported a total of 28 patron-owned applicators in their areas. The other three reported only a few of their patrons had such equipment.

A few of the applicators owned by patrons were rigged on regular farm implements, but in general those owned were completely factory built. Eleven managers of the 15 associations handling nitrogen solutions, or getting equipped to handle them, stated they had encouraged farmers to rig regular farm implements for applying solutions but not many had tried it as yet.



A pull-type applicator sprays nitrogen solutions on a pasture.

Equipment Needs

Managers or fertilizer department heads, or both, were asked, "Does your association have adequate facilities and equipment to take care of present needs?" Responses to the question were as follows:

Does your association have adequate:	Number responding			
	NH ₃		Nitrogen solution	
	Yes	No	Yes	No
Storage or trackage, or both?	9	3	12	2
Applicators or sprayers?	9	3	9	5
Nurse tanks?	10	2	8	6

Many of the associations distributing anhydrous ammonia leased trackage from railroads. Up to 30

days was allowed to unload tank cars. The problem of inadequate storage during seasonal rushes was somewhat alleviated by pumping the material directly from tank cars into nurse tanks.

Although the use of nitrogen solutions was relatively new in the area and most associations had been handling them only a short time, the need for additional application equipment and nurse tanks was already apparent to several associations. Storage was considered adequate by 12 of the 14 associations reporting. However, after operating for a longer period of time, managers may find that transportation and other operating conditions will cause a need for additional storage.

Operating Practices and Policies

This section of the report discusses operating practices and policies on procurement, pricing, credit, sales promotion, and services offered.

Procurement

A reliable source of supply is essential if a cooperative is to provide farm production supplies to farmers in a dependable and efficient manner.

No procurement problems were reported by the 12 associations distributing anhydrous ammonia at the time of this study. All associations were getting their supply from their regional association, Consumers Cooperative Association, which owns and operates anhydrous ammonia

producing facilities at Lawrence, Kans.

All associations paid \$88 a ton, f.o.b. plant, for anhydrous ammonia in the spring of 1959. Equalized, freight costs ranged from \$2.40 to \$17 a ton, depending upon distances from manufacturing plant to local bulk plants. Material was transported to locals by rail or truck.

Many associations distributing nitrogen solutions were having some procurement difficulties. They had been buying material from several sources, but at the time of this study the demand was greater than the available supply. As would be expected, the associations that had been in the business longer were experiencing fewer procurement difficulties.



These anhydrous ammonia storage spheres are located at the source of supply used by local cooperatives.

The prices paid by the associations for nitrogen solutions containing 28 percent nitrogen ranged from \$46.30 to \$48.20 a ton, f.o.b. plant, in the spring of 1959. The prices paid for 32 percent nitrogen solutions ranged from \$52.92 to \$55.10 a ton, f.o.b. plant. The freight charges per ton of material ranged from \$3.18 to \$9 among the associations, depending upon distance from manufacturing plants.

Most of the anhydrous ammonia distributed by the associations surveyed was transported from the manufacturing plant to local bulk storage plants by rail. Some, however, was transported by truck car-

riers. Most of the nitrogen solutions distributed were also transported from manufacturers by rail.

Pricing Policies

All associations charged the going or market price for their liquid fertilizers. Both cooperative and other dealers in the areas surveyed attempted to charge prices that were reasonable for the products and services provided. All patrons within an individual cooperative were charged the same price for the same type of liquid fertilizer with the exception of those two associations

which gave small quantity discounts on purchases.

Price of Anhydrous Ammonia to Patrons

The price of anhydrous ammonia to patrons in June 1959 varied from 6.7 cents a pound for nitrogen, or \$110 a ton, f.o.b. local bulk plant, to 9.76 cents a pound, or \$160 a ton delivered and applied (table 6). Some associations priced anhydrous ammonia on a per-pound-of-nitrogen basis and others priced it on a per-ton basis. If either a per-pound, or a per-ton price was quoted, the other could be calculated on the basis of 1,640 pounds of nitrogen in a ton (anhydrous ammonia is 82 percent nitrogen).

Five of the 12 association managers said the price trend for anhydrous ammonia went downward from 1 to 3 years after they began distribution and then leveled off and remained relatively stable. This situation occurred mainly in areas

where previously there had been only one distributor. The remaining seven indicated little or no changes in prices occurred after the cooperatives entered the business.

In general, the prices paid for anhydrous ammonia by patrons of the associations studied were representative of prices paid by cooperative patrons throughout the surrounding area. In a survey made in August 1958 by CCA, it was found that 52 local CCA affiliates located in Colorado, Iowa, Kansas, and Nebraska priced anhydrous ammonia from 7 cents per pound of nitrogen--or \$114.80 a ton--to 10.5 cents per pound of nitrogen--or \$172 a ton. The most common price ranges were from \$120 to \$125 and from \$135 to \$140 a ton. (See cost section in appendix.)

Price of Nitrogen Solutions to Patrons

The price of nitrogen solutions to patrons of 13 associations reporting ranged from 10.2 cents a pound for

TABLE 6.--Prices paid by farmers for anhydrous ammonia per pound of nitrogen and per ton of product, 12 local farm supply cooperatives, June 1959

Number of associations reporting	Price for nitrogen	
	Per pound	Per ton
1	\$0.0670	\$110.00
3	¹ .0700	115.00
2	.0731	120.00
1	² .0750	123.00
2	.0762	125.00
2	³ .0850	139.40
1	⁴ .0976	160.00

¹ One association included delivery for 7 cents per pound of nitrogen and one charged \$140 a ton if delivered.

² One association offered \$1.25 a ton cash discount.

³ One association gave the following quantity discounts: 5 to 25 tons - one-half a cent and 25 tons or more - 1 cent per pound of nitrogen.

⁴ Included delivery and application charge.

nitrogen, f.o.b. plant, to 13.4 cents a pound delivered and applied (table 7). Expressed in tons, the price range was from \$57.12 to \$75.04 for solutions containing 28 percent nitrogen and from \$65.28 to \$85.76 for 32 percent nitrogen solutions.

Because the use of nitrogen solutions was relatively new in the area surveyed, no significant price trends were noted when the study was made. Managers of the nine associations that had been distributing nitrogen solutions for less than 1 year indicated they could not tell as yet what effect their entering the market might have on prices. The manager of one of the four that had been distributing for 1 or more years said the price had come down 1 cent a pound on nitrogen in his area. The other three, however, indicated no change.

credit policy and three did not. Some policies were strictly enforced and others were not. Five associations operated on a strictly cash basis. Patrons of these associations could make arrangements through their rural credit union or local production credit association if they needed credit.

Four associations gave cash discounts. Two gave a 4 percent and one, a 3 percent discount on fertilizer purchases. The remaining association gave a 3 percent cash discount on all purchases over 500 pounds and a 2 percent discount if the account was paid within 10 days. If not paid in 30 days, the account was referred to the patrons' credit union. Two of the remaining five associations reported a 30-day, two a 10-day, and one a 15-day credit policy.

Credit Policies

Of 17 associations distributing liquid fertilizers, 14 had a definite

Transportation to Farms

The most common method used for transporting both anhydrous am-

TABLE 7.--Prices paid by patrons for nitrogen solutions, per ton of solution and per pound of nitrogen, 13 local farm supply cooperatives, June 1959

Number of associations reporting	Price per pound of nitrogen	Prices per ton of solution	
		28 percent nitrogen	32 percent nitrogen
1	\$0.1020	\$57.12	\$65.28
1	.1070	59.52	68.48
4	.1100	61.60	70.40
1	.1125	63.00	72.00
1	.1150	64.40	73.60
1 3	.1200	67.20	76.80
2 1	.1225	68.60	78.40
3 1	.1340	75.04	85.76

¹ Figures for these associations include delivery and application charge for one association.

² Figures for this association include delivery charge.

³ Figures for this association include delivery and application charge.



A tractor equipped with booms, trailer, and tank was being used by one local for custom application of nitrogen solutions.

monia and nitrogen solutions from local bulk plants to farms was by nurse tanks mounted on specially designed trailers. The trailers were moved by tractor, truck, or jeep. Some products were transported by nurse tanks on skids in regular trucks or farm trailers. As already mentioned, the cooperatives owned most of the nurse tanks; however, some farmers had purchased their own. The specially designed trailers were owned by the cooperatives. Some of the standard trucks and trailers used for hauling nurse tanks to farms were owned by the cooperatives and some were owned by the farmers.

Safety Measures

Safety precautions are important in handling ammonia because it has an irritating action on skin and mem-

branes of the eyes, nose, throat, and lungs.

Information regarding safety measures was available to locals from their manufacturer, CCA, and from the industry. Managers of most of the 12 associations distributing anhydrous ammonia encouraged their personnel to follow these recommendations, but they said it was difficult to do so when rushed. All except one association had water available in case of emergency, and employees used some means of protecting their skin. Only four, however, reported using masks.

In most situations, the hazards associated with handling liquid nitrogen can be avoided by following a few precautionary measures. Some of the more important are:

1. Avoid breathing ammonia fumes. Gas masks should be worn

when there is any possibility of breathing fumes.

2. Protect all skin surfaces from exposure to ammonia. If a full face mask is not worn, wear approved eye goggles.

3. Provide water for emergency treatment. It is important to immediately wash all exposed parts of the body with water. Showers and bubbler-type fountains for the eyes are most desirable.

4. Avoid using ammonia containers for household fuel unless they are thoroughly cleansed with water to rid them of ammonia fumes.

5. Do not attempt to weld or apply an open flame to liquid-handling equipment without first thoroughly cleansing it.

6. Allow only reliable persons properly instructed to perform tank car handling and unloading operations.

These precautions generally apply to all types of liquid nitrogen fertilizers.

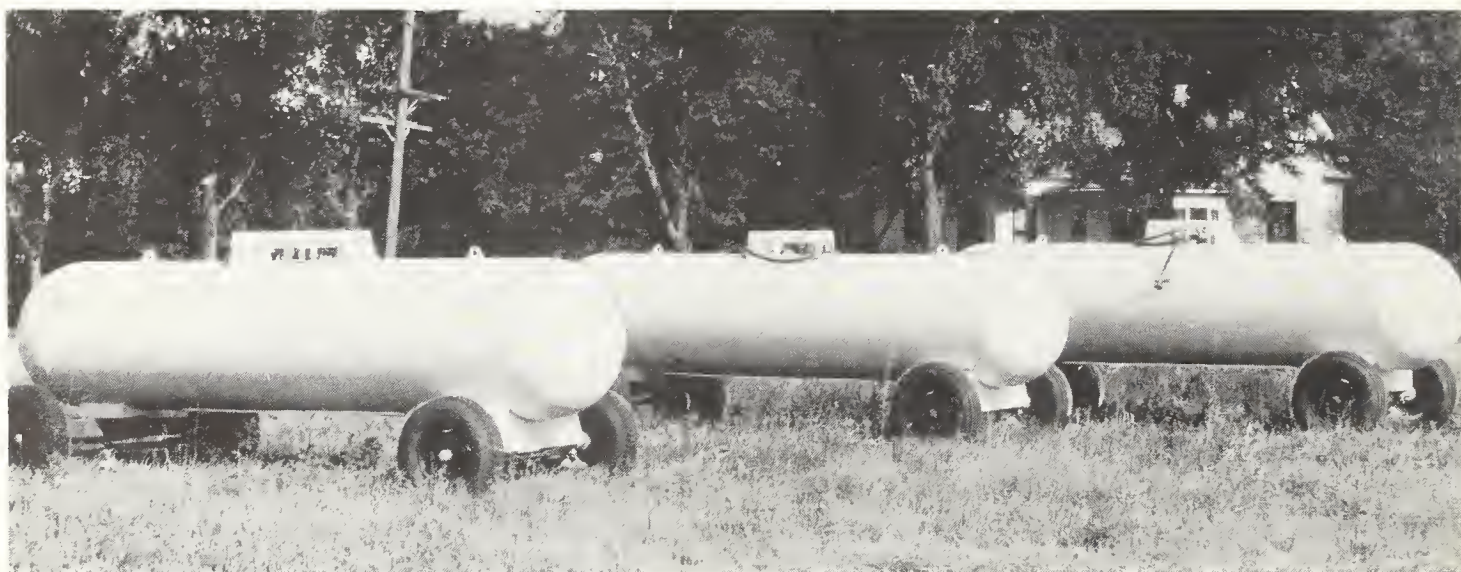
Services Offered

Providing patrons with needed services usually results in greater patronage and volume in distributing farm supplies. This has been especially true with liquid fertilizer, according to most managers offering additional services.

Custom Application Service

In some areas where patrons did not have enough acreage to warrant purchasing their own applicators, cooperatives provided a custom application service for them. Three associations were performing anhydrous ammonia custom application service for patrons at the time of this survey. Two of them charged \$1.50 an acre for a complete service. If patrons furnished the power, the charge was \$1.25 an acre.

Six associations performed a nitrogen solutions custom application service. Their charges were as follows:



Here are typical trailer-mounted nurse tanks used by cooperatives to transport NH_3 from supply tanks to patrons' farms.

Charge for applying
nitrogen solutions

Number of
associations
reporting

\$0.50 an acre	2
.75 an acre	3
72.00 a ton, including cost of material	<u>1</u>
Total	6

Three of the six associations delivered and applied 100 percent and one, 95 percent of all nitrogen solutions distributed. The remaining two did not report such information.

Applicator Rental Service

Although many of the associations surveyed had been distributing nitrogen solutions for only a short while, 11 of the 15 were operating an applicator rental service. They owned 23 applicators for rental purposes. Three of them also did custom application, but managers of the remaining associations said they preferred to make the equipment available and let patrons do their own applying. Generally if nurse tanks were furnished, no additional charge was made if they were returned within a reasonable time. The rental charge, number of associations reporting, and number of rental applicators available to patrons were as follows:

<u>Applicator rental charge</u>	<u>Number of associations reporting each charge</u>	<u>Number of applicators available to rent</u>
\$0.0075 a pound for nitrogen	2	5
.25 an acre	4	6
.35 an acre	2	4
.50 an acre	2	4
No charge	<u>1</u>	<u>4</u>
Total	11	23

Use of Commercial Custom Applicators

Individuals who apply liquid fertilizer for other individuals with their own equipment for a specified charge are referred to as custom applicators. Many cooperatives use the services of these individuals in preference to purchasing applicator equipment and performing the service themselves.

Of the 14 associations distributing nitrogen solutions, 8 were using the services of 28 commercial custom applicators in the spring of 1959. The numbers of associations and custom applicators involved were as follows:

<u>Number of custom applicators for solutions</u>		<u>Number of associations using custom applicators</u>
<i>Range</i>	<i>Total</i>	<i>Number</i>
1 to 3	8	5
4 to 6	4	1
7 to 9	<u>16</u>	<u>2</u>
Total	28	8

Custom applicators were compensated for their services by five of the associations, and patrons in turn settled with their associations.

<u>Rates paid custom applicators for their services</u>	<u>Number of associations</u>
\$0.02 a pound for nitrogen	1
.01 a pound for nitrogen plus \$0.50 an acre	1
1.00 to 1.50 an acre	1
.80 an acre	1
.75 an acre	<u>1</u>
Total	5

The other three supplied the material at the going price, and the applicators made their own arrangements with farmers in regard to application charges. The costs of commercial custom applicators' services are shown in tabulation above.

For information on anhydrous ammonia, see section in appendix on custom applicator services.

Other Services

Questions were asked managers regarding other services offered liquid nitrogen fertilizer patrons. The response was as follows:

<u>Question</u>	<u>Number of managers responding</u>	
	<u>Yes</u>	<u>No</u>
Do you have a soil sampling service?	8	9
Does your association pay for the sample?	6	2
Do you assist the farmer in taking the sample?	6	2
Do you have personnel who can assist farmers with liquid fertilizer application problems?	9	8
Do you carry an inventory of commonly used parts and base for solutions?	12	2
Do you provide a service for overhauling regulators for solutions?	2	12

Of the 17 associations surveyed, 8 offered patrons a soil sampling service. Six of the eight assisted farmers in taking samples, and six also paid for at least one sample per patron. Most managers believed the soil sampling service had been influential in encouraging farmers to use more fertilizer. Some, however, believed the service was of little value either to patrons or their associations.

Nine associations reported having personnel who could assist patrons with application problems. Most of them had fertilizer fieldmen who generally assisted patrons with application problems when time permitted. However, a few who did not have full-time fieldmen had other personnel available to give assist-

ance when needed. Managers sometimes took it on themselves to go out and help patrons with application problems.

In some areas applicator parts can be purchased only from the nearest applicator equipment dealer. Often the dealer may be several miles away, and replacing a broken hose or some other minor part may involve considerable loss of time. Twelve of the local cooperatives distributing solutions, therefore, carried an inventory of the most commonly used parts. Fieldmen and other employees who called on patrons often took a few spare parts along with them on their calls. Only two of the associations were providing a service for overhauling regulators for solutions. Both associations made no charge for the service except for parts. (For additional information on anhydrous ammonia, see section on services in appendix.)

Sales Promotion

The primary objective of the cooperatives was to provide the type of liquid nitrogen fertilizer distribution service their farmer patrons needed. Comparison of fertilizer consumption reports and use recommendations by State experiment stations and other sources indicate that farmers in many areas still are not fully aware of the economics of fertilization. Realizing the need for further education of patrons, several associations included in this study were planning their sales promotion programs accordingly.

In this survey three primary questions were asked regarding sales promotion. The response to each follows:

<u>Question</u>	<u>Number of associations responding</u>	
	<u>Yes</u>	<u>No</u>
Do you have personnel who make farm visits to sell liquid fertilizer?	9	8
If you have such personnel, are they full-time fieldmen?	6	3
Have you held a fertilizer meeting in the last year?	11	6
Did you get any yield comparisons last year from demonstration plots or check strips?	3	14

Nine of the 17 associations surveyed employed personnel as fertilizer fieldmen to work directly with farmer patrons. Six of the nine employed full-time fieldmen and three used fieldmen on a part-time basis. Two associations each had a full-time general fieldman and an additional employee who spent part of his time as a fertilizer fieldman.

Most managers expressed satisfaction with the use of fieldmen. One manager stated it this way: "Our fieldman goes out to sell fertilizer, yes; but not just for the sake of selling. He realizes his customers' needs and uses his knowledge and experience to help them plan a program according to those needs. We feel our fieldman is performing a needed service and our farmers appreciate it."

Eleven of the associations surveyed had held one or more fertilizer meetings or field days during the year. A few of them had held as many as three yearly meetings. Two other managers said they believed this was a good idea, and one of them said he planned to have at least one meeting the next year. Meetings or field days afforded cooperatives a means of bringing patrons up to

date on the latest ideas and practices in fertilization.

Another effective method of promoting fertilizer and educating patrons visually was the use of demonstration plots or check strips. Only three associations, however, had made use of this method in the past year. One had demonstrated with both anhydrous ammonia and nitrogen solution, one with nitrogen solution only, and one with anhydrous ammonia only. Three managers said they had used demonstrations with anhydrous ammonia in the past but believed they were now past that stage in their operation. (For further information, see section on sales promotion in appendix.)

Cooperatives used various types of incentives to promote farm supply sales, including fertilizer. Two types of incentives used most often were: (1) Employee bonuses or commissions, or both, on sales, and (2) price discounts. Although most managers of the associations studied indicated interest in the use of incentives in selling liquid fertilizer, only three had tried it in the past. One had an employee incentive plan, one gave a small discount to patrons for preseason orders, and one had tried a price discount plan in the past, but had discontinued it at the time of this survey.

Patronage Refunds Paid

Most associations paid refunds on fertilizer separately from other supplies but for all fertilizer types grouped together. This method proved generally satisfactory as long as only dry fertilizers were sold. When associations began handling liquid fertilizers, they found that

much higher margins were realized on them than on dry materials. Consequently, more associations now handle patronage refunds separately for liquids, especially anhydrous ammonia.

The response to the question "How are patronage refunds paid on fertilizer?" was as follows:

<u>Response to question</u>	<u>Number of associations</u>
Refunds paid on all supplies together	4
Refunds paid on fertilizer separately	7
Refunds paid on anhydrous ammonia separately	5
No refund paid as yet	1
Total	17

Five of the 12 associations distributing anhydrous ammonia declared patronage refunds on anhydrous separately from that on other fertilizers and supplies. All of the

five paid 12 percent or more on sales of anhydrous ammonia in 1958-59 and the average was 16 percent (table 8). The average gross margin for the associations furnishing data was \$31,001, or 23 percent on an average volume of \$134,821. The portion of the refunds paid in cash averaged 64 percent.

A breakdown of expenses for handling anhydrous ammonia was not available, but if the rate of patronage refunds is used as the rate of net savings, expenses averaged 6.6 percent of sales in 1958-59. Considerable variation existed among associations, however. Gross margins ranged from about 18 to 27 percent, expenses from 1 to 10 percent, and patronage refunds from 12 to 18 percent. The data also indicated that better cost records should be kept in order to determine more accurately net savings realized and patronage refunds justified.

TABLE 8.--Anhydrous ammonia sales, gross margins, patronage refunds as percent of sales, and percent of refund paid in cash by five local farm supply cooperatives, 1958-59

Association number	Volume of sales	Gross margins		Patronage refund as a percent of sales	Percent of refund paid in cash
		Amount	Percent of sales		
	<i>Dollars</i>	<i>Dollars</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
5	\$143,500	\$30,615	21.3	12	70
6	92,000	16,735	18.2	17	50
7	169,425	39,840	23.5	18	80
8	(1)	(1)	(1)	16	50
9	134,360	36,815	27.4	17	70
Average	134,821	31,001	23.0	16	64

¹ Information not available.

Effect of Liquid Nitrogen on Dry Nitrogen Sales

Separate data on sales of dry nitrogen fertilizers for previous years were not available from most associations. However, managers or fertilizer department heads, or both, were asked to what extent they believed liquid fertilizer distribution had affected dry nitrogen sales. Their response

is in the accompanying tabulation.

The effect of liquid nitrogen on dry nitrogen sales appeared to depend largely upon the extent of increased use of nitrogen fertilizer in the area, and the extent that distributors promoted liquid in preference to dry materials.

<u>Effect of liquid fertilizer on dry nitrogen sales</u>	<u>Number of respondents</u>
No noticeable effect	5
Slight decrease	1
Decrease of approximately 15 percent	2
Dry nitrogen sales almost eliminated	6
Dry nitrogen sales completely eliminated	3
Total	17

Farmers' Preferences and Attitudes

As already mentioned, nine associations were distributing both anhydrous ammonia and nitrogen solutions. Six of the nine association managers stated that most patrons who had used anhydrous ammonia preferred it over nitrogen solutions. They used solutions only when soil conditions would not permit anhydrous ammonia application. The primary reasons for this were believed to be lower cost a pound for nitrogen and very satisfactory results from past use. The remaining three association managers said their patrons preferred anhydrous ammonia primarily because of its lower cost.

Nitrogen solutions were gaining popularity, however, and managers

indicated that solutions had increased in importance primarily because of ease of application and adaptability to soil conditions considered adverse to ammonia application. Some patrons, also believed nitrogen solutions were more quickly available to crops. Speed of application and lower labor requirements were considered favorable factors influencing the increased use of both materials.

In response to the question "How do farmers in your area determine the type of fertilizer they will buy?", nine managers said soil tests were most important. Three of them mentioned cost per pound of plant food, two mentioned as most important demonstration plots where farmers

could see effects, and three said the type of products dealers tried to sell farmers was the most important factor.

It was the general opinion of managers of the associations surveyed that there was a place for complete liquid mixed fertilizers in their area. One association was already distributing liquid mixed and four

had plans for adding it in the near future. However, 10 managers believed liquid mixed would not gain widespread popularity in the near future, primarily because of its high comparative cost. Two other managers believed farmers would use it after a little educational and promotional work, but had made no immediate plans for its distribution.

Outlook

Cooperatives must plan for the future if they are to continue to effectively meet the needs of their patrons. Successful managers must keep informed on agricultural conditions, use of fertilizer, and distribution trends and methods in their market area. They need to be adept at anticipating the needs of their farmer patrons.

Future Use by Farmers

In general, farmers' attitudes toward use of both anhydrous ammonia and nitrogen solutions were very satisfactory, according to managers of the associations surveyed. They expected an increase in use of both materials.

Opinions of managers of the 17 associations distributing liquid nitrogen fertilizers are shown below.

Future Plans of Cooperatives

Since managers believed there was a good potential for liquid nitrogen fertilizers in the areas surveyed, they expected to see more new distributors begin operating and many of the existing operations expand. Eight of the 17 managers or fertilizer department heads interviewed were anticipating more aggressive distribution in the future, 7 expected no change, and only 2 expected competition to decrease.

<u>Opinions regarding future use</u>	<u>Number of managers responding</u>
Expect use to increase moderately	6
Expect use to increase sharply	7
Expect use to depend on service and seasonal conditions	3
Undecided	1
Total	<u>17</u>

In view of anticipated trends in the rise in distribution of liquid nitrogen fertilizers, managers of the 17 asso-

ciations were questioned regarding future plans. Their replies were as follows:

<u>Future plans</u>	<u>Number of managers responding</u>
Nine associations distributing both anhydrous ammonia and nitrogen solutions:	
No changes planned	4
Any changes made will depend on future demand	2
Will expand storage facilities	1
Will add delivery and applicator equipment	1
Will encourage farmers to purchase their own equipment, but will expand storage facilities or lease more trackage if necessary	<u>1</u>
Total	9
Three associations distributing anhydrous ammonia only:	
Will add new scales and applicators and lease more trackage	1
Will maintain present facilities and equipment and add nitrogen solutions and liquid mixed fertilizer	1
Will maintain present facilities and equipment and add nitrogen solutions	<u>1</u>
Total	3
Five associations distributing nitrogen solutions only:	
No changes planned	1
Will expand present facilities and add liquid mixed fertilizers	3
Any changes made will depend on future demand	<u>1</u>
Total	5

Observations and Suggestions

These associations were selected for study because of their successful liquid nitrogen operations; therefore, they had relatively few problem areas in need of improvement. Following are a few observations and suggestions, however, which might improve their operations and services to farmers:

1. Provide Complete Services.--Farmers with a limited amount of acreage to be fertilized cannot economically justify buying nurse tanks and applicators. Also, in areas where liquid fertilizers were relatively new, farmers often hesitated to purchase equipment until they were more familiar with its use.

The associations offering a custom application service or the rental of equipment for both anhydrous and nitrogen solutions were meeting a need and increasing volume at the same time. Therefore, those associations not offering these services or located in areas where adequate custom application from individuals is not available should consider adding them as a means of improving their present operations and services.

2. Improve Peak Season Operations.--Managers indicated that solutions can be applied over a wider range of soil and weather conditions than anhydrous ammonia; therefore,

the handling of both products would permit the associations to distribute solutions during periods when weather and soil conditions were unfavorable for anhydrous ammonia. With the big demand for anhydrous ammonia coming in the spring, adverse weather conditions sometimes delayed operations and created additional problems. Some associations

met this situation by operating day and night and by obtaining trackage which enabled them to hold tank cars longer and load nurse tanks direct.

3. Encourage Fall Use of Liquids.--This would permit more efficient use of facilities and labor. Little liquid fertilizer was used in the fall in the areas covered, but



Field demonstrations show results of fertilizer use. Top: Strip at left was not fertilized. Strip on right had 40 pounds of NH_3 per acre applied in the fall after wheat was up. Bottom: Aerial view of demonstration on field of wheat. The luxuriant growth shown in the " NH_3 " area is the result of anhydrous ammonia application.

cooperatives might encourage more fall application by: (1) Using demonstration plots or check strips; (2) holding more meetings to inform farmers of approved fertilization practices; and (3) setting up a patron incentive plan such as discounts for fall orders.

4. Encourage Prompt Return of Equipment.--Some associations renting nurse tanks or applicators, or both, to patrons on a per-acre or per-pound basis, or lending them without charge, were having difficulty in getting some patrons to return them after use. This resulted in the need for investment of additional equipment. Patrons need to be reminded frequently of the inconvenience and extra costs that result from delays in returning equipment. Cooperatives might also consider penalties or charges for equipment not returned within a specified time.

5. Take Proper Care of Equipment and Follow Safety Measures.--Constant attention should be given to the proper cleaning and servicing

of equipment for nitrogen solutions to prevent corrosion. Employees also need to be reminded frequently of the need for following safety precautions at all times, but especially during busy seasons of the year.

6. Keep Better Records.--More complete records on the distribution of liquid fertilizer would provide management with information on the expenses and savings of the service. They would also provide a more accurate basis for determining patronage refunds justified on this type of business. Sales in dollars and quantities, cost of sales, and gross margins should be kept separately on anhydrous and on nitrogen solutions. Direct expenses could be kept and an allocation of general overhead made for the two liquids combined. This information would provide net savings on total liquids and indicate whether a different refund would be justified on anhydrous than on solutions. In all cases, it appeared that different refund rates were justified for liquid than for dry fertilizers and other farm supplies.

Appendix

The material reported herein was taken from a survey made in August 1958 by the Consumers Cooperative Association, Kansas City, Mo., and analyzed by the writer of this report. The survey covered 55 local members of CCA. The material included here is supplemental information on anhydrous ammonia operations in the immediate and surrounding areas covered in the main part of the report.

Cost of Anhydrous Ammonia to Patrons

The prices paid for anhydrous ammonia f.o.b. plant by patrons of 52 local associations as of August 1958 were as follows:

<u>Price at plant</u>		
<u>Per ton</u>	<u>Per pound of nitrogen</u>	<u>Number of associations reporting</u>
\$ 114.80	\$.0700	2
115.00	.0701	2
118.00	.0719	1
120.00	.0731	11
123.00	.0750	3
125.00	.0762	4
128.00	.0780	1
129.80	.0786	1
130.00	.0792	4
131.00	.0800	1
131.20	.0800	3
132.00	.0804	1
134.00	.0817	1
134.80	.0817	1
135.00	.0823	2
139.40	.0850	4
140.00	.0864	7
147.60	.0900	1
164.00	.1000	1
172.20	.1050	<u>1</u>
Total		52

The cost to patrons ranged from \$ 114 to \$ 172 a ton. The associations

pricing in the higher range were generally located further from the source of supply; therefore, freight charges for long-distance hauls helped justify higher prices to some extent. There was also an indication of a lack of competitive pricing for some locations.

Sales Promotion

Questions regarding sales promotion were sent to 55 association managers. The response and the number responding were as follows:

<u>Question</u>	<u>Number of managers responding</u>	
	<u>Yes</u>	<u>No</u>
Do you have personnel who make farm visits to sell anhydrous ammonia?	28	26
Are they full-time fieldmen?	7	21
Have you held a fertilizer meeting during the past year?	23	30
Did you get any yield comparisons last year from demonstrations or check strips?	14	37

Of the 28 associations reporting use of field personnel to promote anhydrous ammonia, 7 had full-time fieldmen and the remainder had part-time men.

Services Offered

Several types of services related to anhydrous ammonia were offered by the 55 associations.

Equipment Rental Service

Forty-two associations offered a rental service for anhydrous

ammonia applicators. The number owned per association and the total owned by all associations were as follows:

<u>Number of rental applicators owned per association</u>	<u>Number of associations reporting</u>	<u>Total number of applicators</u>
1	7	7
2	10	20
3	8	24
4	5	20
5	4	20
6	5	30
8	2	16
10	<u>1</u>	<u>10</u>
Total	42	147

Applicator rental charges made by the 42 associations were as follows:

<u>Rental charge</u>	<u>Number of associations reporting</u>
Per day:	
\$10.00	2
Per pound of nitrogen:	
\$0.005	4
.01	5
Per acre:	
\$0.25	6
.35	1
.50	20
.60	1
.75	2
No charge	<u>1</u>
Total	42

Some associations made an additional charge for nurse tanks as follows:

<u>Rental charge for nurse tanks per association</u>	<u>Number of associations reporting</u>
Per pound of nitrogen:	
\$0.005	3
Per acre:	
\$0.10	1
Per tank per day:	
\$3.00	2
5.00	6
10.00	3
Per tank:	
\$1.00	1
7.00	1
Per ton:	
\$1.00	1
For field tanks plus applicator:	
\$0.005 per pound of nitrogen	1
.75 per acre	1
No charge	¹ 27
No response	2
Charge not established	<u>1</u>
Total	50

¹ One association made no charge for the first 24 hours, but charged \$5 a day for all time over 24 hours.

One association not included above made the following rental charge: 500-gallon tank, \$3 a day; 1,000-gallon tank, \$5 a day; 1,000-gallon tank plus trailer, \$10 a day.

Custom Applicator Service

A total of 194 individuals were performing an anhydrous ammonia application service for patrons of 37 of the 55 associations studied. Fourteen associations paid the individuals directly for their service as follows:

<u>Method of payment</u>	<u>Number of associations</u>
A-Commissions:	
\$0.005 per pound of nitrogen, if sales were 50,000 pounds or more	1
.005 per pound of nitrogen	1
.005 per pound of nitrogen for 5-25 tons; and	
.01 per pound of nitrogen for more than 25 tons	1
.50 an acre	1
2 percent commission on sales	1
B-Discounts:	
\$2.00 a ton	1
Graduated tonnage rate:	1
25-39 tons \$3.00 50-59 tons \$5.00	
40-49 tons \$4.00 60 and over \$6.00	
\$4.00 a ton	1
5.00 a ton	2
10.00 a ton	1
14.00 a ton	1
18.00 a ton	1
20.00 a ton	1
	<u>1</u>
Total	14

Other Services

Responses to questions regarding other services were as follows:

<u>Question</u>	<u>Number of associations responding</u>	
	<u>Yes</u>	<u>No</u>
Do you have a soil sampling service?	29	23
Do you take or assist in taking samples?	13	16
Do you provide a service for overhauling pumps and regulators?	24	29
Do you have personnel who can make farm calls to assist with application problems?	39	13
Do you have an inventory of commonly used parts?	40	13

The data in appendix tables 1 to 3 show properties of liquid nitrogen fertilizers available to the associations studied from their regional cooperative supplier.

Appendix table 1.--Composition of liquid nitrogen solutions

Product	Volatile ammonia	Ammonium nitrate	Urea	Water
<i>Percent</i>				
Non-pressure 32 percent	0	44.3	35.4	20.3
28 percent	0	38.8	31.0	30.2
21 percent	0	60.0	0	40.0
Low-pressure Co-op No. 1	22.2	65.0	0	12.8
Co-op No. 2	26.3	55.5	0	18.2
Co-op No. 3	16.6	66.8	0	16.6
Aqua ammonia	30.0	0	0	70.0
High-pressure Anhydrous ammonia	100.0	0	0	0

Appendix table 2.--Density and nitrogen content of liquid nitrogen solutions

Product	Specific gravity at 60°F	Weight per gallon per 60°F	Nitrogen content (by weight)	Nitrogen per gallon of solution
<i>Pounds</i>				
Non-pressure 32 percent	1.327	11.06	32.00	3.54
28 percent	1.280	10.67	28.00	2.98
21 percent	1.287	10.73	21.00	2.25
Low-pressure Co-op No. 1	1.137	9.48	41.00	3.89
Co-op No. 2	1.079	9.00	41.00	3.69
Co-op No. 3	1.188	9.91	37.00	3.67
Aqua ammonia	0.896	7.47	24.68	1.84
High-pressure Anhydrous ammonia	0.618	5.15	82.25	¹ 4.24

¹ A 100-gallon tank would have only 360 pounds of anhydrous ammonia because it can be filled only to 85 percent of capacity with this product.

Appendix table 3.--Pressure, and salting-out, freezing, and boiling temperatures of liquid nitrogen solutions

Product	Pressure per square inch gauge at 104°F	Salting-out temperature ¹	Freezing temperature ²	Boiling point ³
	<i>Pounds</i>		<i>Degrees F</i>	
Non-pressure 32 percent	0	32	-16	(4)
28 percent	0	0	-16	(4)
21 percent	0	47	1	(4)
16 percent	0	11	(4)	(4)
Low-pressure Co-op No. 1	10	21	-100	78
Co-op No. 2	17	-25	-100	69
Co-op No. 3	1	48	-100	101
Aqua ammonia	11.4	-112	-112	78
High-pressure Anhydrous ammonia	211	-108	-108	(4)

¹ Highest temperature at which crystals can form.

² Highest temperature at which solution can freeze solid.

³ Temperature at which vapor pressure is zero pounds per square inch gauge.

⁴ Not applicable.

OTHER PUBLICATIONS AVAILABLE

Farmer Cooperatives in the United States, FCS Bulletin 1.

Methods of Financing Farmer Cooperatives, General Report 32. H. H. Hulbert, Nelda Griffin, and K. B. Gardner.

Farmers Buy Supplies Cooperatively, Bulletin Reprint 3. J. Warren Mather.

Controlling Open Account Credit in Feed Cooperatives, FCS Circular 24. Charlie B. Robbins and Lacey F. Rickey.

Credit Control in Selected Retail Farm Supply Co-ops, General Report 57. T. R. Eichers.

Inventory Management by Selected Retail Farm Supply Co-ops, General Report 70. J. M. Bailey.

Bulk Distribution of Fertilizer and Lime in the Northeast, General Report 24. Warren K. Trotter.

Bulk Distribution of Lime by Selected Cooperatives In Three Southern States, Service Report 49. B. H. Pentecost.

Manufacture of Fertilizer by Cooperatives in the South, FCS Bulletin 13. Warren K. Trotter.

Fertilizer Distribution: Methods and Costs, Service Report 19. M. A. Abrahamsen.

Distribution of Fertilizer by Cooperatives in the South, FCS Bulletin 11. Warren K. Trotter.

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